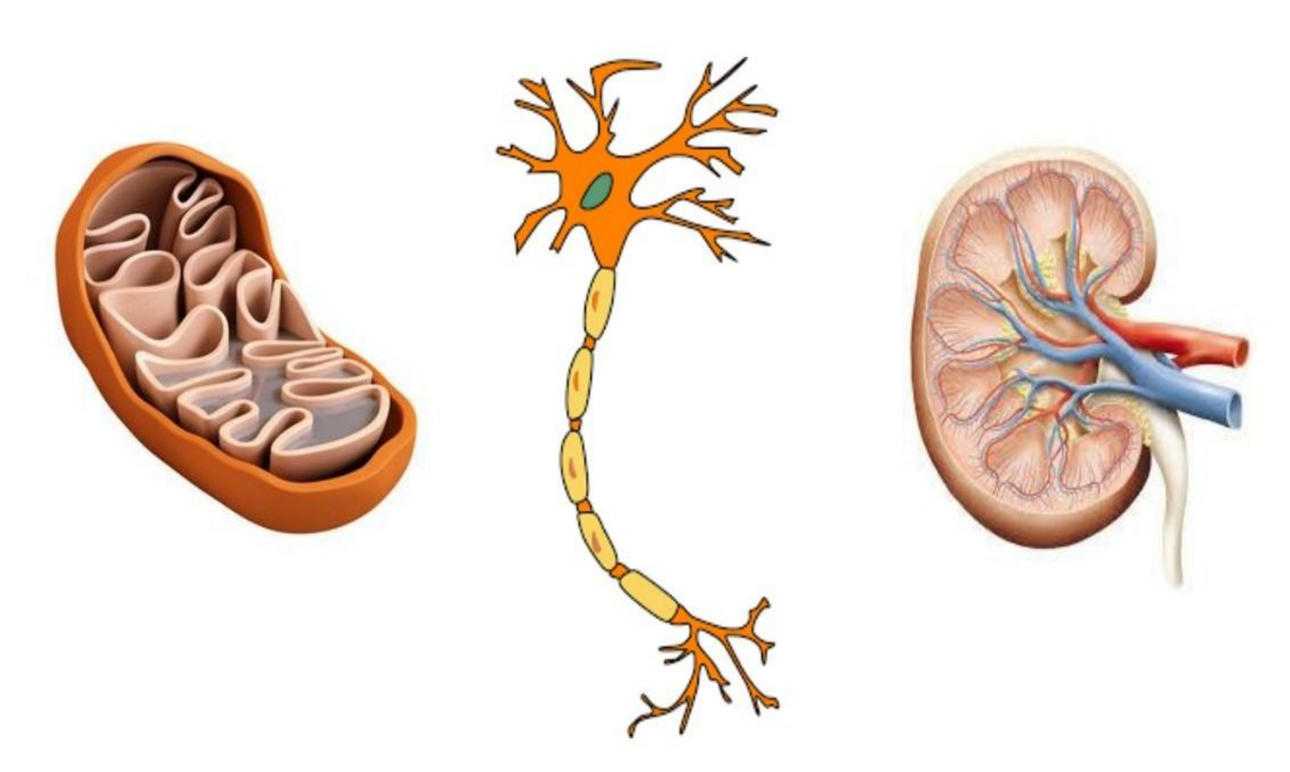
Geel 2000 Language Schools

Biology

Science Department

2nd Sec.



2024 / 2025

Name : ………………………

Class : ………………………

Chapter one

Nutrition in living organisms [Lesson One]

Nutrition

-The scientific studying of food and various modes of nutrition.

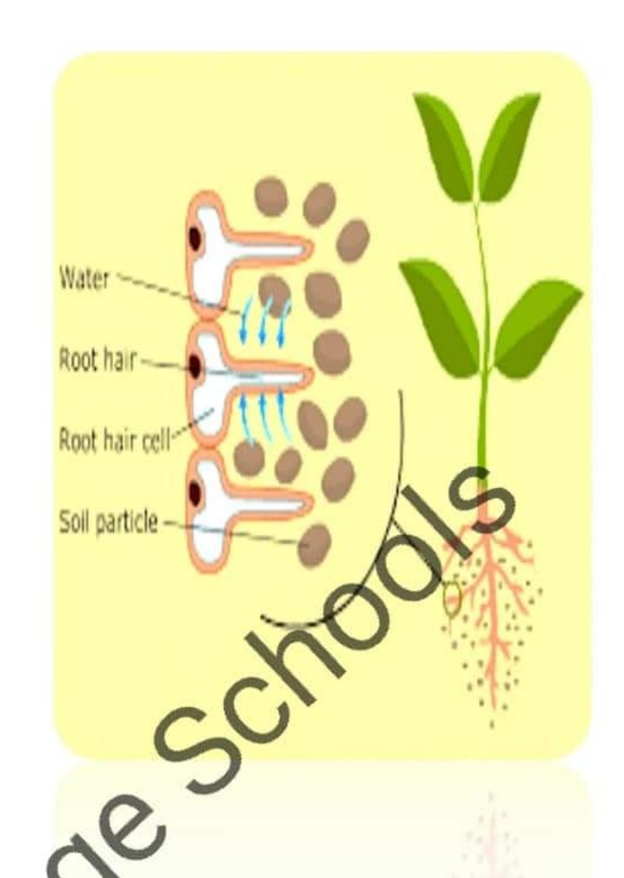
Types of nutrition

P.O.C.	Autotrophic nutrition	Heterotrophic nutrition
Definition	(Autotrophs) Self feeding organisms.	(Heterotrophs) Depend on other living organisms to get their food.
Kind of food	Inorganic ,simple &low energy substances as: H_2O ,CO_2 ,mineral salts	Organic ,complex & high energy substances as : Proteins ,carbohydrates, fats.
The process	Photosynthesis	Digestion
Example	Green plants -some bacteria.	➢ -Holozoic { herbivores : feed on plants carnivores : feed on animals omnivores: feed on plants & animals) ➢ parasites : Bilharzia ➢ saprophytes : fungi & bacteria .

Autotrophic nutrition (Nutrition in green plants)

- Process of absorption of water and salts.
- Process of photosynthesis.

Absorption of water (Root hair):



Location: Extend from the root epidermis (piliferous layer).

Length: 4mm.

life time: Exist for few days or weeks and regenerated from the **zone of elongation.**

Function: Fixation and absorption of water and salts.

Adaptation of the root hair to its function

- **Thin walls**: to pass water and salts easily
- **Large in number**: to increase the area of water and salts absorption
- **Secret viscous substances**: to find their way easily in the soil and help in fixation of the plant
- **The conc. of the solution in its vacuole is more than that of the soil**: to absorb water from the soil by osmosis.

Mechanism of water absorption

Diffusion:

It is the passage of molecules or ions from high conc. medium to low conc. medium this is due to the free motion of molecules.

Osmosis:

It is the passage of water from high conc. to low conc. medium through semi-permeable membrane due to osmotic pressure

Osmotic pressure:

The pressure that causes the diffusion of water through semi-permeable membrane from high conc. medium of water to low conc. medium of water it depends on conc. of solutes.

Note

The relation between the concentration of solutes in solution and the osmotic pressure is directly proportional.

i.e. Osmotic pressure increases by the increase in the concentration of solutes in the solution.

Osmotic pressure

concentration of solutes

Permeability:

The ability of membranes to allow the passage of some substances and prevent others.

Examples:

- Cellulosic wall → allow the passage of all substances
- Lignin, suberin and cutin walls → do not allow passage of water and salts
- Plasma membranes → have selective permeability ,

As they allow the passage of water, control the passage of salts according to cell needs regardless of their size, charge or concentration.

Imbibition:

The ability of some colloidal sub. to absorb water, swell and increase in volume

Ex: cellulose, protein and starch

Mechanism of water absorption by the root:

- Root hairs are covered with viscous substances that absorb water from soil by imbibition
- Epidermal cells absorb water by osmosis as the conc. of solution in their cell vacuole is higher than that of the soil.
- Water passes from the epidermis to the cortex till reaching xylem by osmosis.

Absorption of mineral salts:

The plant needs certain essential elements (other than carbon , hydrogen and oxygen) . It can absorb these elements through the root.

Deficiency of the mineral salts causes:

- Disturbance in plant growth and may stop completely.
- No flowers or fruits formation.
- These elements are divided into two groups.

Macro-nutrients	Micro-nutrients
• (Seven elements) • Needed in large amounts. • Needed for growth • **Examples:** P , S ,Ca , N_2, Fe , Mg , K -Some mineral salts as nitrates , phosphates and sulphates convert carbohydrates into proteins. - Phosphorus enters in composition of energy carrier compounds . - Iron is important for the building up of some enzymes. -Magnesium enters in composition of chlorophyll pigments.	• (Eight elements) • Needed in few amounts (trace elements). • Act as co-enzymes • **Examples:** Al , Cu , Mn , Zn , Mo , B, Cl_2 , I_2

Mechanism of absorption of minerals

- By diffusion
- By selective permeability: according to cell needs
- By active transport

Active transport:

It is the passage of any substance from low concentration to high concentration across the plasma membrane by using chemical energy.

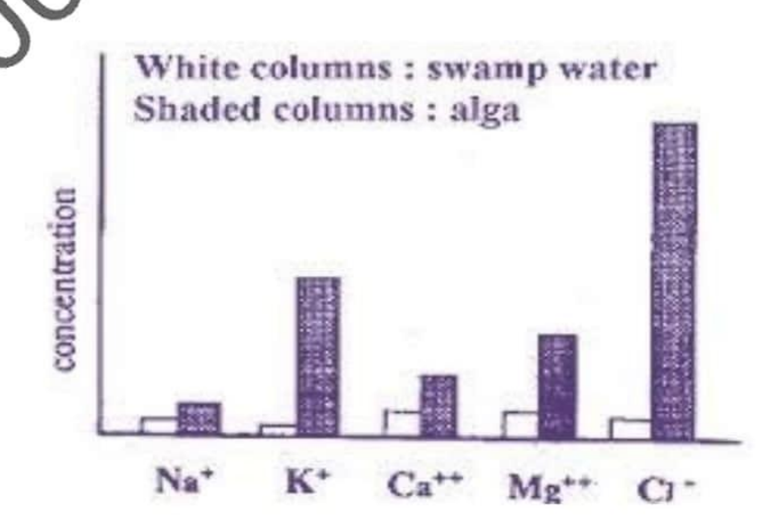
Example :

(Nitella algae)

Live in swamps where salt concentration in the cells is more than that of the water so it absorbs minerals by active transport using chemical energy produced from aerobic respiration

*** The graph shows :**

1) The concentration of various ions accumulating in the cell sap of this alga is higher than their concentration in the water of the swamp.
2) That the concentration of some ions accumulating in one cell is higher than in another , this proves that the ions are selectively absorbed according to cell requirement.



Lesson 2

Photosynthesis in Green plants

Site of occurrence of photosynthesis

1- Green leaves

2-Green herbaceous stem

(contain chlorenchmya)

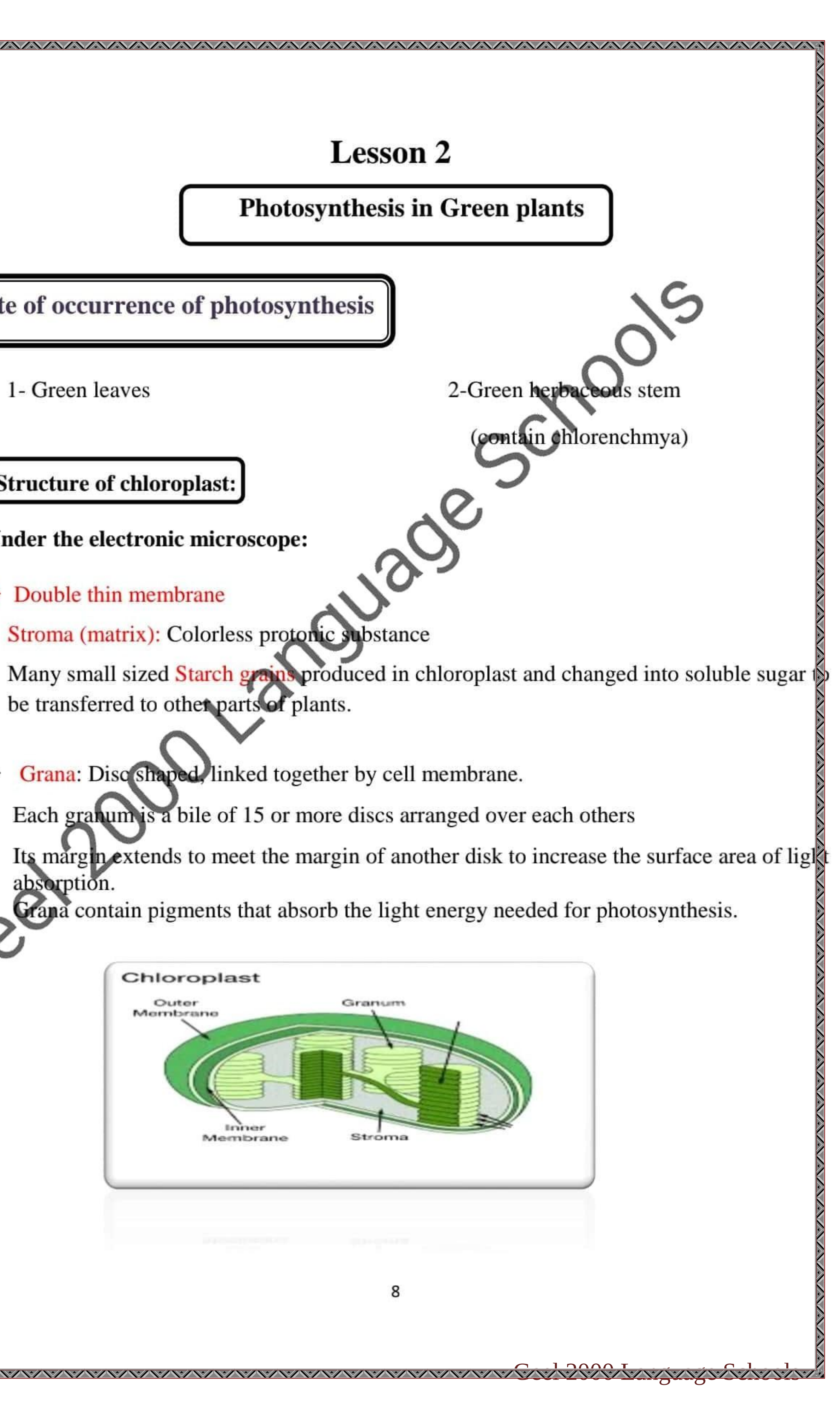
Structure of chloroplast:

Under the electronic microscope:

- Double thin membrane
- Stroma (matrix): Colorless protonic substance
- Many small sized Starch grains produced in chloroplast and changed into soluble sugar to be transferred to other parts of plants.

- Grana: Disc shaped, linked together by cell membrane.

- Each granum is a bile of 15 or more discs arranged over each others
- Its margin extends to meet the margin of another disk to increase the surface area of light absorption.
- Grana contain pigments that absorb the light energy needed for photosynthesis.



Main pigments in chloroplasts:

Pigment	Colour	Ratio
Chlorophyll A	Blue – green	70%
Chlorophyll B	Yellow – green	
Xanthophyll	Lemon – yellow	25%
Carotene	Orange – yellow	5%

Green color dominates the other colors of pigments

Due to the high ratio of chlorophyll pigments.

- **Importance of Chlorophyll : Absorption of light energy.**
- **Importance of Chlorophyll : Absorption of light energy.**
- **Structure of chlorophyll :** Chlorophyll ($C_{55}H_{72}O_5N_4Mg$) , Magnesium is in the center of the molecule.

Structure of the leaf

1 The upper and lower epidermis

- One row of barrel-shaped parenchyma cells – no chlorophyll – covered with cutin except the stomata to decrease the water loss.
- Stomata spread throughout the epidermal layer.

2 The mesophyll

Palisade	Spongy
Towards the upper epidermis	Towards the lower epidermis
Large no. of chloroplast	Few number of chloroplast
Narrow intercellular spaces	Wide intercellular spaces
Cylindrical elongated parenchyma cells	Loosely arranged cells
For photosynthesis process	For photosynthesis and Aeration.

3 The Vascular Tissue

- Contains large number of vascular bundles ,the main one is in the midrib.

In the vascular bundle there are rows of xylem towards the upper epidermis and Phloem towards the lower epidermis.

Mechanism of photosynthesis

- **Van Neil**

studied the sulphur bacteria they contain **Bacteriochlorophyll** that make their own food by splitting H_2S

Into H_2 and S by using light energy and bacteria chlorophyll.

H_2 is used to reduce CO_2 to form Carbohydrates.

The source of oxygen evolved during photosynthesis:

- Chlorella algae are provided with all conditions needed for photosynthesis, water contains isotope ^{18}O and CO_2 contains ordinary oxygen .O_2 evolved is O^{18}likes H_2O.
- when the exp. Was repeated using H_2O^{16}, O_2 evolved is O^{16}like water.

so the source of oxygen during photosynthesis is **(water).**

The general equation for photosynthesis in green plants is :

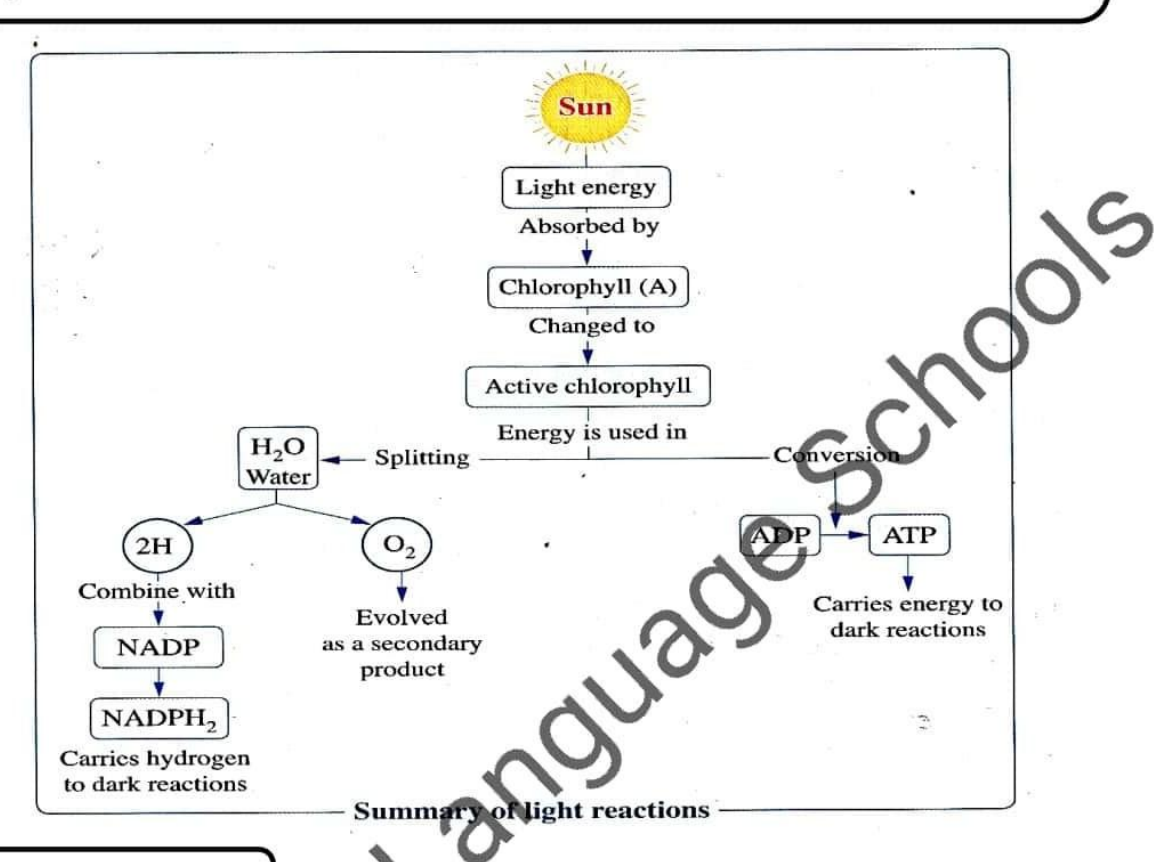
$$6CO_2 + 12H_2O \xrightarrow[\text{Chlorophyll}]{\text{Light energy}} C_6H_{12}O_6 + 6H_2O + 6O_2\uparrow$$

The light and dark reactions: (Studied by Blackman)

P.O.C	Light reactions	Dark reactions
1- Site	in the grana	in the stroma
2-Limiting factor	Light	Temperature depends on enzymes
3-Time of occurrence	in the presence of light only	Light or dark after exposing to light
4-End products	ATP,O_2&H_2	glucose, H_2O

1- Light reactions:

It is a group of reactions that occur in granum inside the green plastid as it contains chlorophyll pigment and the light is the limiting factor of the rate of photosynthesis.



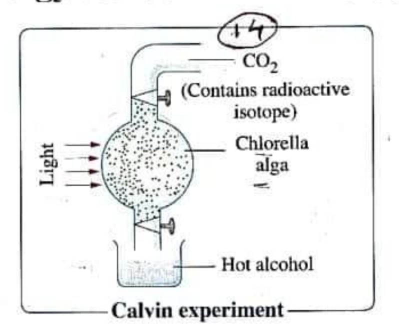
Summary of light reactions

2- Dark reactions:

It is a group of reactions that occur in the stroma of chloroplast in which the temperature is the limiting factor for the rate of photosynthesis. So , these reactions can occur in light and darkness.

Don't FORGET!

In Dark reactions that, hydrogen carried on $NADPH_2$ is used to fix CO_2 gas into carbohydrates with help of energy stored in ATP Molecule.



Calvin experiment

- Melvin Calvin revealed the nature of the dark reactions by using the radioactive Isotope of carbon C^{14}.

Notes

- The first stable compound during photosynthesis.is PGAL . Phosphoglyceraldehyde contain 3 carbon atoms.

May changes into glucose, fats , or consumed to get energy in respiration.

- ATP (Adenosine Triphosphate) : Energy currency of the living cells.

-NADP (Nicotinamide Adenine Dinucleotide) : Act as hydrogen receptors.

-**Important isotopes:**

^{14}C	**Used by Melvin Calvin to reveal dark reactions**
^{18}O	To prove the source of O_2 evolved during photosynthesis

Heterotrophic nutrition

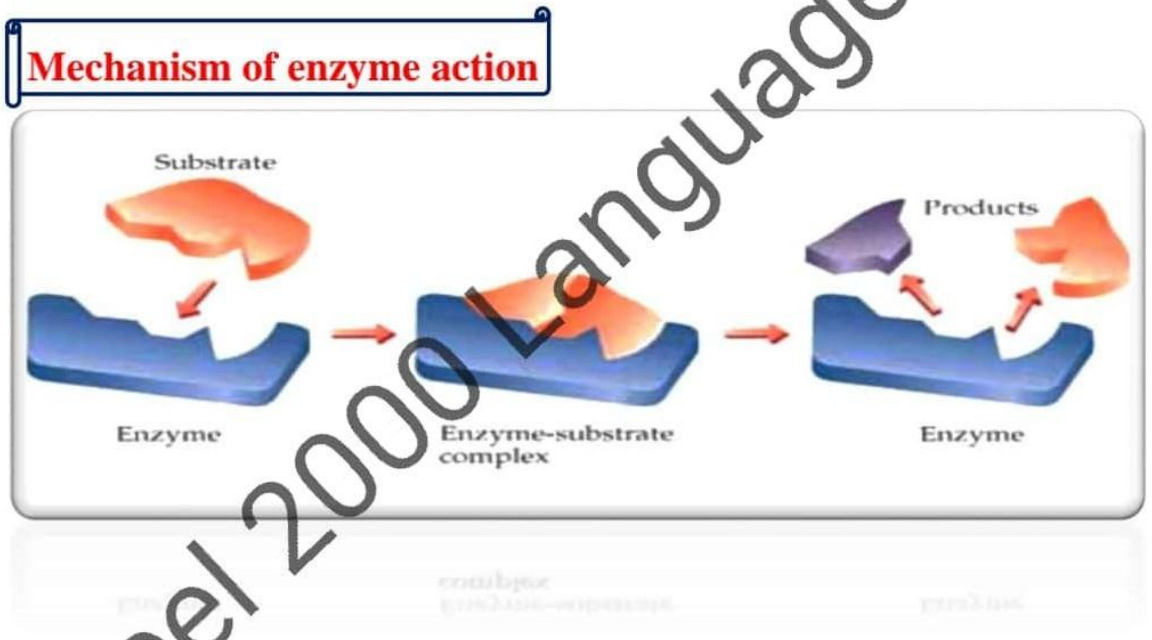
Digestion:

Converting of large food molecules (polymers) into smaller ones (monomers) By means of hydrolysis in the presence of enzymes.

Enzyme

Protein substance that act as catalyst to activate certain chemical reactions.

Mechanism of enzyme action



Characteristics of enzymes

- **Specific:**

  Each enzyme can accelerate only one type of reaction.

- **DO not affect the products of the reaction**

  As they work as catalysts increasing the rate of the reaction until it reaches the equilibrium.

- **<u>Most have a reversible effect</u>**

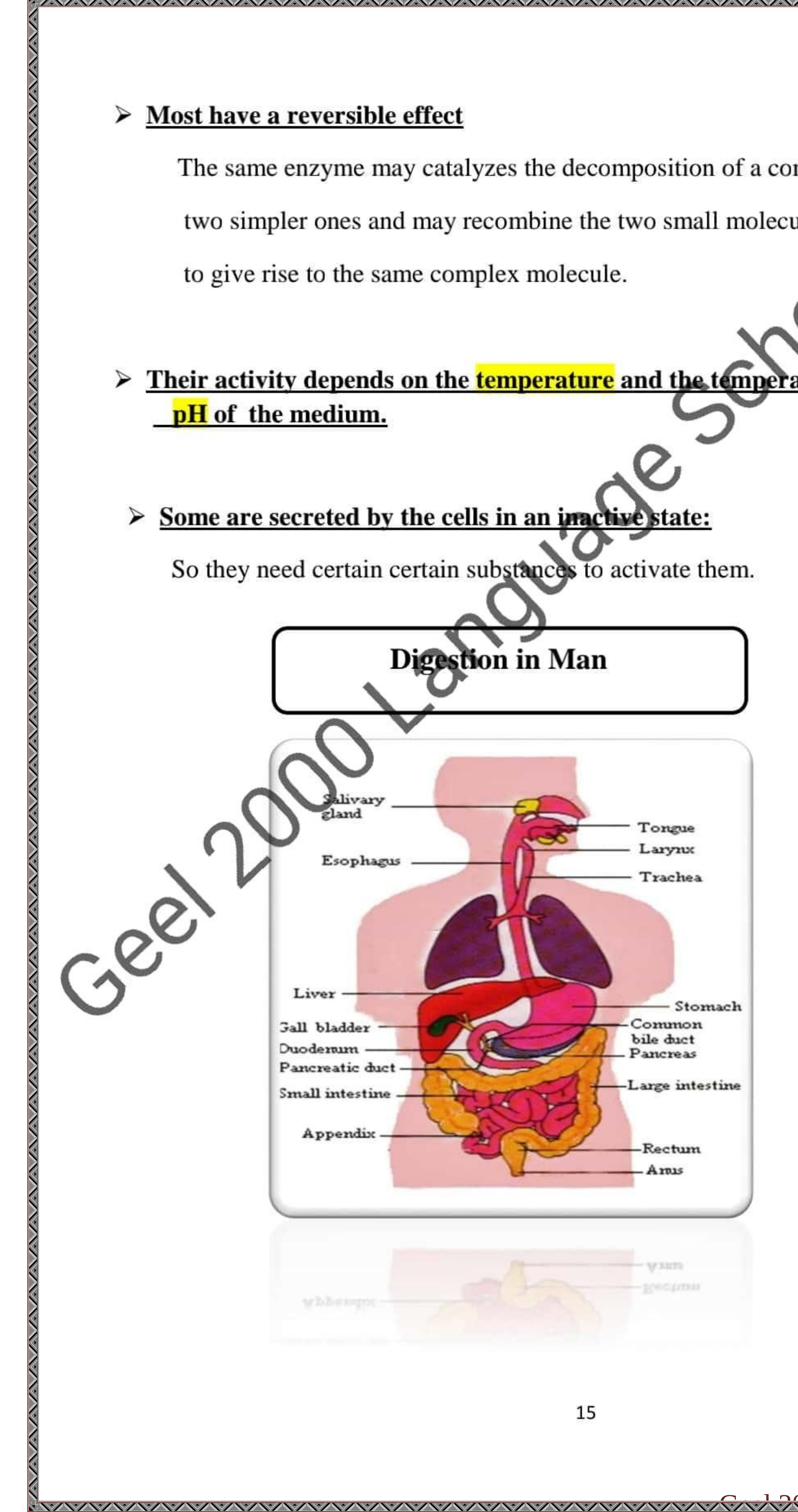
  The same enzyme may catalyzes the decomposition of a complex molecule into two simpler ones and may recombine the two small molecules to give rise to the same complex molecule.

- **<u>Their activity depends on the temperature and the temperature and the pH of the medium.</u>**

- **<u>Some are secreted by the cells in an inactive state:</u>**

  So they need certain certain substances to activate them.

Digestion in Man

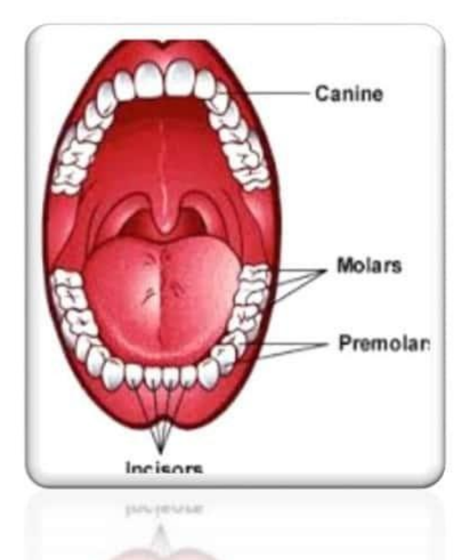


Structure of digestive system in human

- **Digestive (alimentary) canal:** **[consists of]**
  Mouth , pharynx , esophagus , stomach , small intestine , large intestine , Rectum & anus opening.

- **Accessory (associated) glands:** which are :
  Salivary glands , Liver & pancreas

Steps of Digestion



1- Buccal digestion (in mouth)

- **Mouth:** **The first part of the digestive system.**
  which contains :

❖ **Teeth : Differentiated into:**

- **Incisors:** In front of jaw for **cutting** food.
- **Canines:** Following incisors to **tear food.**
- **Premolars and Molars :** At the back , for **crushing and grinding food.**

❖ **Tongue :**

- The organ of taste.
- Manipulate the food to be chewed by the teeth .

❖ **Salivary glands :**

- Three pairs.
- Secrete Saliva that contains :

{**Mucus** to facilitate the food swallowing }

{**Amylase (Ptyalin) enzyme** that converts starch into sugar.}

Starch + Water - - - - - - - - - - - →	**Maltose sugar** (**Disaccharide**)

- **Pharynx:**

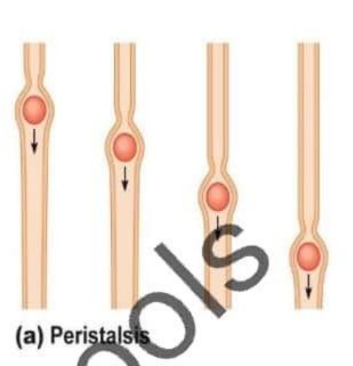
Common cavity at the back of the mouth leads to **two tubes:**

❖ Oesophagus. (a part of the digestive system).
❖ Trachea . (a part of the respiratory system).

Remember!

Swallowing process is an organized reflex action, when food is pushed from the mouth to the esophagus the top of the trachea and the larynx are elevated together causing the epiglottis to close the entrance of air so the food doesn't pass to trachea.

- **Esophagus :**



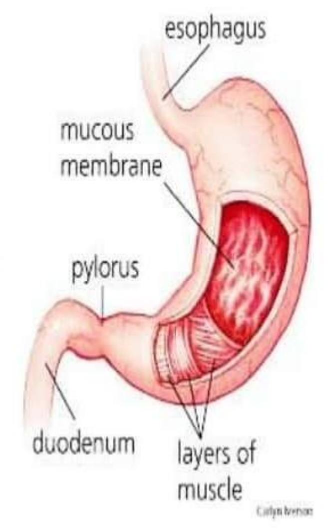
- Extend from the **pharynx** downward through the neck & into the **chest cavity** .
- About 25 cm. long.
- Lies parallel to the vertebral column.
- Lined with glands for secreting mucus.
- Food carried through it to the stomach by **Peristalsis.**

Peristalsis: Series of rhythmical contraction & relaxation of the circular muscles extends along the alimentary canal.

- **Importance of peristalsis:** 1- Helps in digestion &absorption of food.

  2-Mixing of food with the digestive juice.

2-Gastric digestion: (in the stomach):



- The stomach is muscular sac lies in the abdominal cavity.
- Stomach is joined to the esophagus by **cardiac sphincter** and connected to the

  small intestine by **pyloric sphincter.**



Proteins : are the only food substances which are digested in the stomach by The Gastric juice.

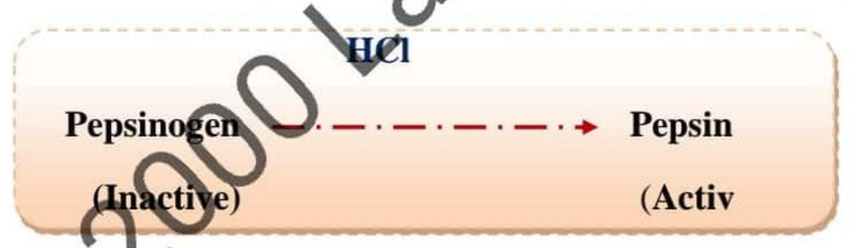
➢ The Stomach secretes **gastric juice** (colorless acidic liquid) which consists of:

- 90% water.
- HCl acid .
- **Pepsin Enzyme** which is secreted in an inactive form called **Pepsinogen .**

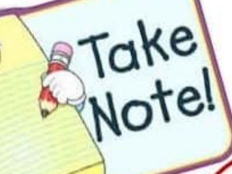
Functions of HCl

➢ **Creates an acidic medium (1.5 : 2.5 PH) which :**

- Kills harmful bacteria.
- Stops the action of ptyalin enzyme.
- Activates pepsinogen (inactive) enzyme to active pepsin.



Protein +water —(Pepsin / HCl)→ **Polypeptides**



Although the stomach is made up of protein , the gastric juice doesn't affect it this is due to :

- Mucus layer
- Pepsinogen will be activated only when it mixed with the acid in the cavity of the stomach.

3 - Intestinal digestion:

➢ **Small Intestine**

- The small intestine consists of **duodenum** and **ileum.**
- -It is about 8 meters long and 3.5 cm in diameter to 1.25 in its end.
- Coils and loops of it connected together by membranous structure

  called **mesentery.**

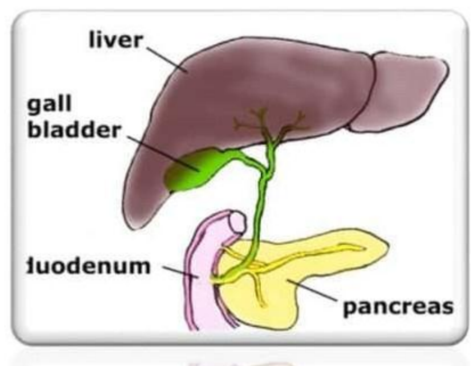
- The juices that help to digest food in the small intestine are:

1-The bile:

- -It is secreted from the liver
- -It emulsifies fats (dividing large masses of fats into small globules to facilitate and accelerate the enzymatic action on fats that don't dissolve in water.

Fats —·—·—·—·—·→ (**Bile juice**) **Emulsified fats**

2-Pancreatic juices:



- -It includes

➢ **Sodium bicarbonate:**

Neutralize HCl and renders (makes) the medium alkaline **(PH = 8)**

➢ **Pancreatic amylase**:

- It catalyzes the hydrolysis of **glycogen** and **starch** into **Maltose**

Starch & glycogen + water	Pancreatic amylase Alkaline medium	Maltose Malt sugar)

➢ **Trypsinogen:**

- It is an inactive enzyme.
- It becomes active **trypsin** in the duodenum by the **coenzyme enterokinase**

Trypsin catalyze the hydrolysis of **proteins** to **polypeptides.**

Protein + water	Trypsin -------------→ Alkaline medium	Polypeptides

➢ **d)Lipase:**

- Catalyzes the hydrolysis of the **emulsified fats** into **fatty acids** and **glycerol**.

Emulsified fats + Water	Lipase -------------→	Fatty acids + Glycerol

3) Intestinal juice:

- Secreted by certain cells in the wall of the **small intestine** contains a mixture of enzymes
- -These enzymes complete the action of the previous enzymes
- These enzymes are:

➢ peptidases:

- It is the number of enzymes. Each one is concerned with Hydrolysis of peptide linkage between certain kinds of amino acids in the Polypeptide chains to give different amino acids.



➢ Enzymes which hydrolyze disaccharides to monosaccharides:

These are

- -**Maltase**:
  - ❖ Which hydrolyze **maltose** to **two molecules of glucose**

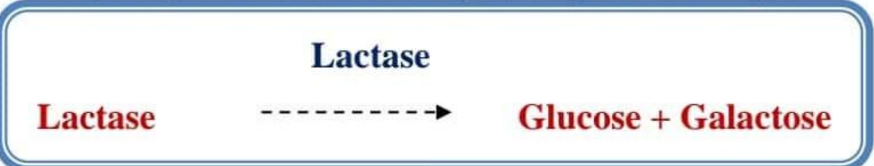
Maltose	Maltase ------------→	Two molecules of glucose

- -**Sucrase**:
  - ❖ Which hydrolyze **sucrose** to **glucose** and **fructose.**



- **Lactase**:

❖ Which hydrolyze **lactose** (milk sugar) to **glucose** and **galactose**



- **Enterkinase** :
    - It acts only as a **co-enzyme** to activate **trypsinogen.**



Absorption:

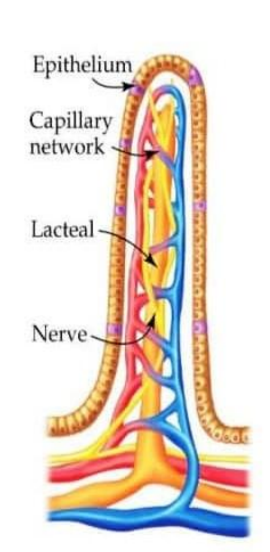
- **It is the passage of the digested food from mucosa of ileum to the blood or lymph by active transport & membranal diffusion .**

Or

- **It is the transfer of digested food to the blood and lymph**

Villi

- The inner epithelial lining of the ileum is **folded** to form **villi.**
- The surface area increases to about 10 m^2.
- About 5 times much as the surface area of the human body surface.



Structure of the a Villus

- **Epithelial layer**

Each villus consists of outer single layer of epithelial cells which enclose a lacteal surrounded by a network of venous and arterial blood capillaries.

➤ **Micro-villi**

-Tiny projections from epithelial cells of the villi called micro-villi. They increase

The area of the absorbing surface.

The routes of absorption of digested food substances by Villi

P.O.C	Blood route	Lymphatic route
Absorbed substances	amino acid, glucose, other monosaccharide, some salts, water and, water soluble vitamins	fatty acids , glycerol, oil soluble vitamins (A, D, K , E)
Pathway	Blood capillaries in villi ----- ---- hepatic portal vein----- liver--- hepatic vein ---- inferior vena cava----- right atrium of the heart.	villi ----- lacteal vessels ---lymphatic vessels --- bigger lymphatic vessels ---- superior vena cava ----- right atrium of the heart

Metabolism:

It is the process by which the body can utilize the absorbed food.

❖ This process takes place:

➤ **Anabolism:**

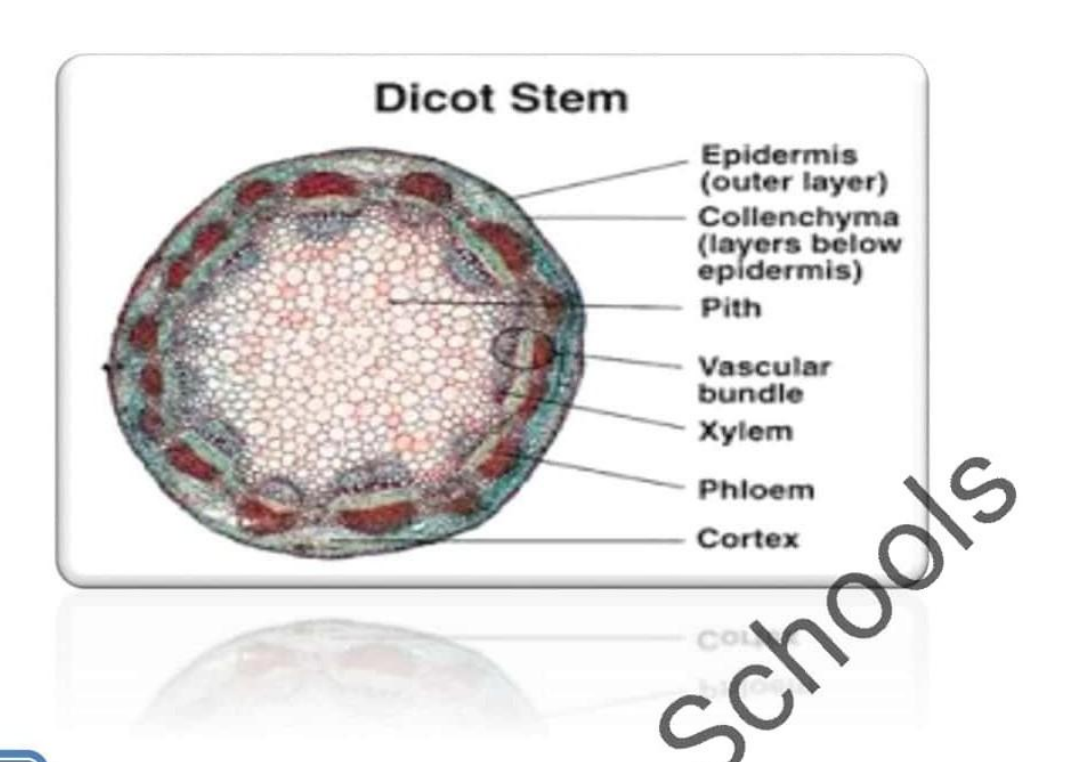
The simple and small sized food particles can be changed into complex compounds.

➤ **Catabolism:**

The absorbed food, especially the glucose can be oxidized to the produce the energy required for the activity of the body.

Large intestine and defecation:

- Undigested food passes to the large intestine.
- The most important function of the large intestine is the absorption of water and salts from the undigested residue to leave semi- solid feaces.
- Presence of bacteria in the large intestine is responsible for the bad odour and Breakdown of these remains into simple substances.
- Waste remains expelled through the anus by strong muscular contractions of the rectum accompanied by relaxation of the two muscles of the anal sphincter situated on both sides of the anus.
- The mucosa of large intestine secretes mucus to facilitate the passage of feaces to outside.



Epidermis:

- One row of adjacent. barrel –shaped parenchyma cells covered by cuticle.
- To decrease water loss and protection .

Cortex:

- **A) Collenchyma cells.**
  (Several row of cells, thickened corners by **cellulose**)

Function:

- Supporting and making photosynthesis.
- **B) Parenchyma cells.**
  (Several rows with wide **intercellular spaces**)

Function:

- Aeration of stem .
- **C) Starch sheath.**

(innermost row of cortex)

Function: storing of starch .

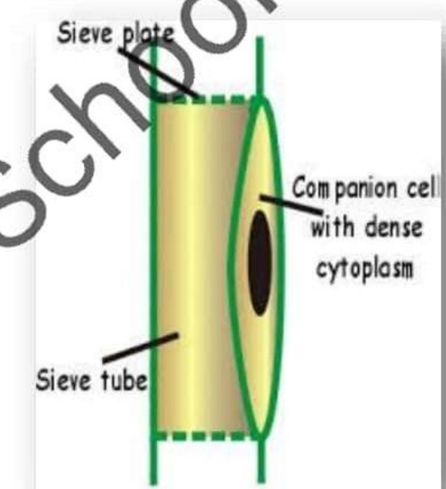
Vascular cylinder:-

- **A) Pericycle :** (Parenchyma cells and fibers)

Function:

- make the stem strong and elastic.

- **B)Vascular bundle**:
- (arranged in cylinder each one is triangular in shape its base directed outwards the bundle consists of the following **Phloem , Cambium & xylem**) .



1-Phloem:

It is the outer tissue of the vascular bundle.it consists of

- **Sieve tubes:-**

Elongated cells, they contain cytoplasm without a nucleus

The cross- walls which are perforated by tiny pores through which cytoplasmic strands extend from one tube to another.



- **Companion cells:-**

-Each sieve tube has a nucleated companion cell .

2- Cambium:

-It lies between the phloem and xylem.

Function:

Divided to give rise externally to secondary phloem and internally to secondary xylem

3-Xylem: It is the internal part of the bundle consists of Vessels & Tracheid.

Steps of formation of vessels:-

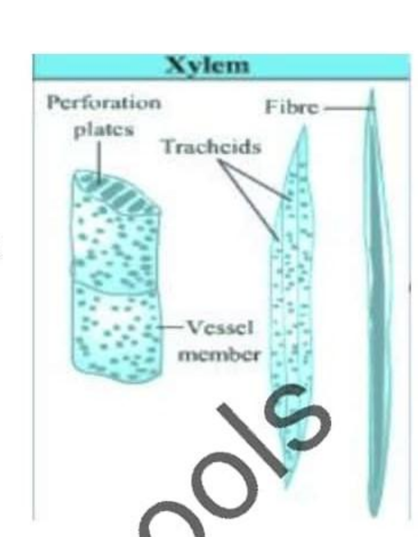
- The transverse walls have been completely dissolved appears in T.S in circular from, its ends are opened.
- Cellulose wall has become thickened by lignin.
- The protoplasmic content has died leaving hollow vessel.
- Tracheid appear in the T.S in a **pentagonal** or **hexagonal** from their ends pointed and closed.

Note:-

Numerous **pits** are scattered all over the wall where the primary wall is left without Thickening. These pits permit water to pass from inside the vessel to outward.

Lignin is laid down on the inner lining of the vessel to **support** the vessel and **Prevent the collapse of its wall.**

Vessel	**Tracheid**
Transports large amount of H_2O	Transports of small amount of H_2O
Circular in T.S	Pentagonal or hexagonal in T.S
opened End	closed End
Have Pits	Have pits



Pith:

- **Shape:** parenchyma cell occupy the center of the stem
- **Function**: storage.

Medullary rays:

- **Shape:** parenchyma cells extend bet .vascular bundles
- **Function:** join the cortex with the pith.

Mechanism of transport in higher plants

Theories explain the ascent of water in plant:-

1-Root pressure theory:-

- If the plant stem is cut very near to the soil level, we can see the exudation (exiting) of water from the stump.
- This phenomenon is known as **Exudation** . which occurs due to the root pressure continuing to force water up the plant.

Root pressure:

The pressure in the root due to the direct absorption of water by Osmosis.

Exudation:

The existence of water from plant stem that cut near to the soil level

- **No reasonable explanation of ascent of water to high levels in tall trees by root pressure due to:**

- Root pressure does not exceed 2 atmospheres.
- Root pressure is affected by external factors.
- Some plants like conifers do not have root pressure.

2- Imbibition theory:-

- The colloidal nature of cellulose and lignin in the wall of the xylem vessels helped them to imbibe water.
- This phenomenon has limited effect on ascent of sap.
- The sap **ascends through the cavities** of xylem vessels and **not along the walls only.**

3-Capillarity theory:-

The rising of water in very narrow tubes.

- **Xylem Vessels are considered as capillary tubes (0.2 :0.5 mm) in diameter.**
- It is a weak secondary force for ascent of sap as **the finest capillary tube** does not allow the rise of water more than a height of **150 cm.**

4-Transpiration pull – Cohesion –Adhesion theory:-

By Dixon and Joly .

- They proved that the principal forces which pull the water upward to very high levels 100 m through xylem vessels depending on the following :

Force	Evidence	Condition
Cohesive force between the molecules of water in xylem vessels.	Existence of continuous column of water.	The tube must be free of any air bubbles to avoid any breaking of water column.
Adhesive force between water molecules & the walls of xylem.	Water column held against the effect of gravity.	Walls must have adhesive force to attract water.
Transpiration pull originated from transpiration in leaves.	Attract the water column upward due to transpiration.	Tubes must be a capillary tubes.



Some seedlings, when transplanted from a nursery, to open soil, Fail to grow if they remain exposed to the sun for a long periods of time

Due to the presence of air bubbles.

Path of sap during its ascent from root to the leaves:-

- Transpiration decreases the water concentration in the air chamber above the stomata in the leaf.
- Evaporation will increase from the mesophyll tissue.
- Pulling force attracts water from the surrounding cells.
- Pulling force continues as far xylem elements in veins till the midrib of the leaf to xylem vessels in stem and root.

Transport of food from the leaves to all parts of the plants:

- **The phloem transports food in all directions (upward and downward)**

Role of sieve tubes transportation of ready-made food:-

The two scientists Rapeden and Bohr

Steps	Observation
Supplied a green bean leaf with CO_2 contains C^{14} to carry cut photosynthesis	Plant produces carbohydrates.
Traced the path of carbohydrates.	Carbohydrates are trans located upwards & downwards.



Steps	Observation
1-The insect penetrates the tissue of the plant till reaches the sieve tubes by its piercing mouth tissue.	1-food passes from the mouth of the insect to its stomach.
2-He separated the whole body of the insect from its mouth parts , he collected The sample of the sieve tube.	2- Sample consists of organic sub.
3-He sectioned the region of the plants where the proboscis of the insect was inserted.	3-proboscis was inserted in a sieve tube by its piercing mouth parts.

Conclusion:

- The absorbed food by the insect was the food of phloem that was transported to al plant parts.

The mechanism of organic substances transport in the phloem:-

➢ Thain and Canny

- Could see long cytoplasmic threads which contain organic substances inside the sieve tubes which is known by cytoplasmic.

Cytoplasmic streaming

The circular movement to the cytoplasm inside the sieve tubes and companion cells.

The transportation process is delayed with the decrease of temperature or oxygen in cell, thus delaying the movement through the cytoplasm tube (sieve tubes).

Transportation in Animals:

- **In small animals (Protozoa and Hydra) :**

Both gases and food substances are transported by diffusion.



- **In bigger and more complicated animals :**

By specialized transport systems.

Human Transport system:

Transport in human body takes place through two system which are:

- **Circulatory system (Blood vascular system)**
- **Lymphatic system.**

Circulatory system

It is a closed circulatory system (Form a complete circuit).

Structure of human circulatory system

1-The

2-Blood vessels

3-Blood

➢ The Heart

- Hollow muscular organ which nearly in the middle of the chest cavity.
- 2-It is enclosed in **the pericardium** to protect the heat and facilitate its pumping action.
- 3-It is divided into **4 chambers**. the upper two chambers called **atria** .

They **have thin muscular walls**. They **receive** blood from the **veins.**

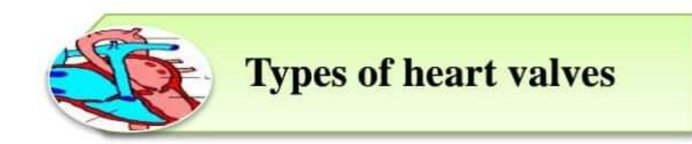
- The lower chambers with thick muscular walls called **Ventricles** pump The blood through arteries

➢ The heart is divided longitudinally into **2 sides** by means of muscular walls:

Right side | **Left side**

- Each side has an atrium and ventricle connected together by an opening which is guarded by a **Valve** with thin flaps whose free edges are attached by Tendons to the ventricle wall, to prevent the flaps from turning inside out. So the blood is **allowed to flow from Atrium to ventricle, but not in the reverse direction.**

- 4-The right atrium is connected to the right ventricle through an opening by, a **tricuspid valve (3 flaps).** The left atrium is converted to the left ventricle through a **bicuspid valve (2 flaps) or mitral valve**.



Type	Location	Function
1. Tricuspid valve; (consists of 3 flaps)	Between the right atrium and right ventricle.	Allows blood to pass from the right atrium to the right ventricle (in one direction) not in the reverse direction.
2. Bicuspid valve (mitral valve): (consists of 2 flaps)	Between the left atrium and left ventricle.	Allows blood to pass from the left atrium to the left ventricle (in one direction) not in the reverse direction.
3- Semilunar valves (aortic &pulmonary valve)	At the connection of the heart with both aorta and pulmonary artery.	Allow blood to pass from the two ventricles to the arteries in one direction (prevent blood from returning to the ventricles).

Heart beats

- Origin of heart beat .Cardiac tissue the heart continues beating regularly even after it ha been disconnected from the body the cardiac nerves.

- **The origin regular rhythm of heart beat is due to the presence of two muscular nodes:-**

1-Sino –atrial node (pacemaker)

- Bundle of cardiac muscle fiber near the connection of right auricle and the large vein in the **right atrial wall.**

- It is considered as the **Pacemaker of the heart.**
- Beats at regular rate of 70 beat /minute (normal rate).
- It sends impulses over the two atria to stimulate their contraction.
- It is connected to 2 nerves:
  - A nerve **decreases** the rate of the heart beats during **sleep and in sadness (grief)**
  - A nerve **increases** the rate of the heart beats during **joy , after walking up & effort.**
  - So the no. of heart beats changes according to the **physic**al & **psychological state of the body.**

2-A trio – ventricular node:-

a- Found at the junction between atria and ventricles.

b- Receive electric impulse then sent it through special fibers **(Hess fibers)** to the walls of ventricles to stimulate them to contract.

❖ Sounds of heart beats :

Two sound are distinguished in the heart beat:

Long and low pitched (lubb),

Due to closure of the 2 valves between the atria and ventricles during Ventricular contractions.

Short and high pitched (Dupp).

Due to closure of the aortic and pulmonary valves during ventricular relaxation.

➢ Blood Vessels

Include Arteries , Veins and blood capillaries.

Arteries	Veins
(1) **Carry blood away from the heart**	**(1)** Carry blood towards heart
(2) **Carry oxygenated blood except pulmonary artery**	**(2)** Carry deoxygenated blood except pulmonary veins
(3) **Walls are thick and elastic to withstand pressure.**	**(3)** Walls are thin and less elastic.
(4) **Absence of valves**	**(4)** Presence of valves the sites of these valves can be observed in the arm veins when the arm is tied tightly above the elbow this was discovered by William Harvey
(5) **They have narrow cavity**	**(5)** They have wide cavity
(6) **Pulsate**	**(6)** No pulsate
(7) **They are buried among body muscles**	**(7)** They are near to the body surface.

The wall of the artery is built of 3 layers:-

1) **The outer layer** : coat of connective tissue
2) **The middle layer:**

it is relatively thick and consists of involuntary muscles which contract & relax under the control of nerve fibers so it can pulsate to pump the blood.

3) **The inner layer** :

it is endothelium which lines the inner surface of the artery it consists of one row of tiny epithelial cells. that gives elasticity to the artery to be able to pump the blood during contraction of ventricles.

Capillaries:

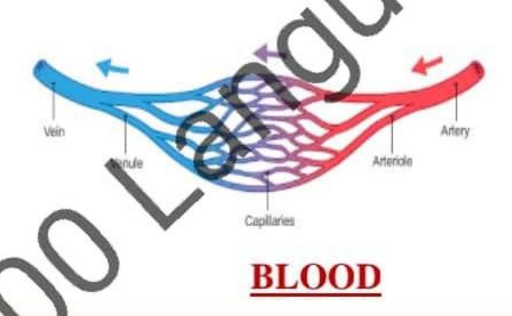
1) The microscopic vessels (7-10 micron diameter).

2) They connect the artery with veins (end of artery and beginning of veins)

This fact was discovered by **Malpighi** toward the end of the 17th century and this was the completed work of **Harvey.**

3)Thin walled consists of one raw of thin epithelial cells with tiny pores between .them to facilitate the quick exchange of substances blood and tissue cells.

4)Their wall thickness is 0.1 micron .They spread in the space between the cells all supply them with all their requirement of food and oxygen.



BLOOD

The principal medium in the process of transport.

Color: red viscous liquid.

PH: It is weakly alkaline PH=7.4.

Volume : 5 to 6 litters of blood.

Structure: connective consists of :

A) Plasma **B)** Red blood cells

C) white blood cells **D)** Platelets

A Plasma

- The tissue fluid of blood.
- It represents 54% of the blood volume.
- It contains:
  - **90% water.**
  - **7% proteins** as: albumin, globulin & fibrinogen.
  - **1 % inorganic salts**: e.g. .Ca^{++}, Na^{+}, Cl^{-}, HCO_3^{-}.
  - **2% other components** as absorbed food (amino acids, sugars), wastes (urea) ,hormones & enzymes.



- **RBCc**
- **WBCc**

A-Erythrocytes (RBC)	B-Leukocytes (WBC)
4-5 million/mm³ in male and 4-4.5 million /mm³ in female.	About 7000 mm³ , it increase during Sickness
Red in color due to the presence of the Hemoglobin Formed of protein and iron	Colorless.
Biconcave has no nucleus	Contains a nucleus.
Its age doesn't exceed 4mouths (120 days) And it is destroyed in liver , spleen and inside bone marrow.	Some kinds of it live from 13 to 20 days.
Produced in bone marrow .	Produced in bone marrow , spleen and lymphatic system

Function	Function
1-Transport of Oxygen from the lungs to all body parts. the Hemoglobin binds with O_2 from red oxyhemoglobin , **2- Transport CO_2 from all body parts to the lungs.** The hemoglobin combines with CO_2 to from Carbo-amino hemoglobin.	• Attack foreign particles and produce antibodies. • Protect the body against diseases.

C • Platelets

- **Number:** 250 thousand / mm^3.
- **Formation**: Produced from bone marrow.
- **Age**: lives for 10 days.
- **Shape:** Non cellular Important in clotting.
- **Size:** one fourth of the RBCs.
- **Function:**; play a role in blood clot after the injury.

Blood Clot

- It occurs when a blood vessel is cut.
- **Importance of clotting**: Blood forms a clot to prevent bleeding before it leads to shock followed by death.

The mechanism of blood clotting.

1- **Blood platelets +Destroyed Cells** —(Factors of clotting in blood)→ **Thromboplastin**

2- **Prothrombin** —(Thromboplastin +Ca^{++} Factor of clotting)→ **Thrombin**

Formed in liver by help of vitamin k → (Active enzyme)

3- **Fibrinogen** (Soluble protein) —(Thrombin)→ **Fibrin** (Insoluble protein)

Why does blood not clot inside blood vessels?

1- Blood runs in normal fashion and does not slow down.
2- Platelets should also side easily and smoothly inside the blood vessels in order not to be broken.
3- Due to the presence of heparin secreted by the liver, which prevents conversion of prothrombin to thrombin

Blood vessel
Red blood cell
White blood cell
Platelet
PLASMA

Functions of the blood:-

1) Transport of digested food. Oxygen, CO_2 ,waste hormones and enzymes.
2) Controlling metabolism and keeping body temperature at 37 ˚C.
3) It regulates the internal environment (Homeostasis) such as osmotic potential, quantity of water in the tissues and PH value of the tissues.
4) Protection of the body against microbes , pathogenic.(bacteria)
5) Formation of blood clots.(protection from bleeding) .



- The blood is a viscous liquid which circulate within arteries and veins smoothly by the process of heart beats, but to pass through the blood capillaries it needs a pressure.
- **The maximum blood pressure:** is measured as **ventricle contract.**
- **The minimum blood pressure :** is measured as **ventricle relax.**

The returning of the blood to the heart depends on :

- A) the skeletal muscles near the veins (put a pressure on the walls of the vein)
- B) valves of veins (that prevent the backward flow of the heart).

Measurement of blood pressure

.

By mercuric instrument [Sphygmomanometer] :-

It's reading consists of two numbers:

Maximum : During ventricular contraction .(**Cystolic**)

Minimum : During ventricular relaxation . (**Diastolic**)

Note: The mercuric instruments are more accurate than the digital ones.



120/80 mmHg is the normal value of blood pressure at youth.

120 as the ventricle contract (**cystolic**) and 80 as they relax (**Diastolic**).

Note : Blood pressure increases gradually by aging and it must be under medical control to avoid its harmful effects..

Blood circulation in Human

Blood circulation in man is divided into three main pathways as follow:

A-Pulmonary circulation:

- It start from the right ventricle ends in the left atrium.

1- when the right ventricle contracts the deoxygenated blood will rush through the Pulmonary artery through the semi – lunar valve.

2- The pulmonary artery gives rise into 2 branches .each branch goes to a lung where it branches to form several arterioles which end as blood capillaries around the alveoli where exchange of gasses take place ,CO_2 & water vapor will diffuse from the blood and oxygen will move towards it . so blood becomes oxygenated.

3- Oxygenated blood returns from the lung through 4 pulmonary veins (2 veins from each lung) to open into the left atrium.

B- Systemic circulation

- It starts from the left ventricle and ends in the right atrium.

1- When the left ventricle contracts the oxygenated blood rushes from the left ventricle to the aorta. Through the semilunar valve.

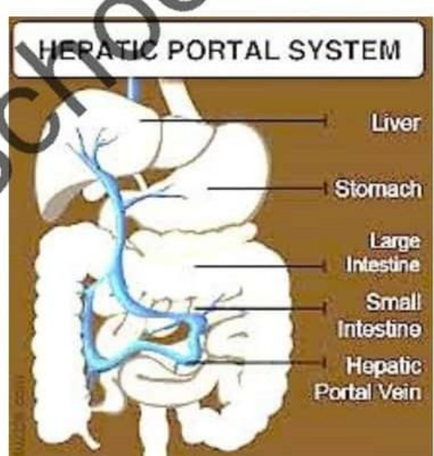
2- The aorta gives rise to several arteries, some which move upward while others go downward end by blood capillaries the cells transporting oxygen water and food substances to them and take CO_2 the blood becomes deoxygenated .

3- Blood capillaries collect to give rise to larger veins which pour their deoxygenated blood to the right atrium. Through superior and inferior vena cava.



The contraction of the right side of the hear occurs at the same time of the left side contraction so pumping the deoxygenated blood from the right ventricle and pumping of oxygenated blood from the left Ventricle, both take place at the same time.

C-Hepatic portal circulation:-



It starts from the blood capillaries of villi of the small intestine and ends by blood capillaries inside the liver.

1)- Glucose & amino acids are transported to the blood capillaries inside the villi after being absorbed by them.

2-) The blood capillaries aggregate into small and large venules finally pour their contents into the hepatic portal vein ,also they receive veins from spleen ,pancreas and the stomach.

3)-Hepatic portal vein branches into venules (when it first enters the liver) which end with minute blood capillaries. Excess food substances which exceed the body needs filter through the capillary walls and pass to the liver where they undergo certain changes.

4)-blood capillaries unite into the hepatic vein which leaves the liver to pour its contents into the upper part of the inferior vena cava before it enters the right atrium.

Lymphatic System

- It is the immune system of the body as it defends and produces antibodies that give the body immunity .
- Spleen is considered one of the most important lymphatic organs in the body.
- Lymphatic system consists of:

1 • Lymph

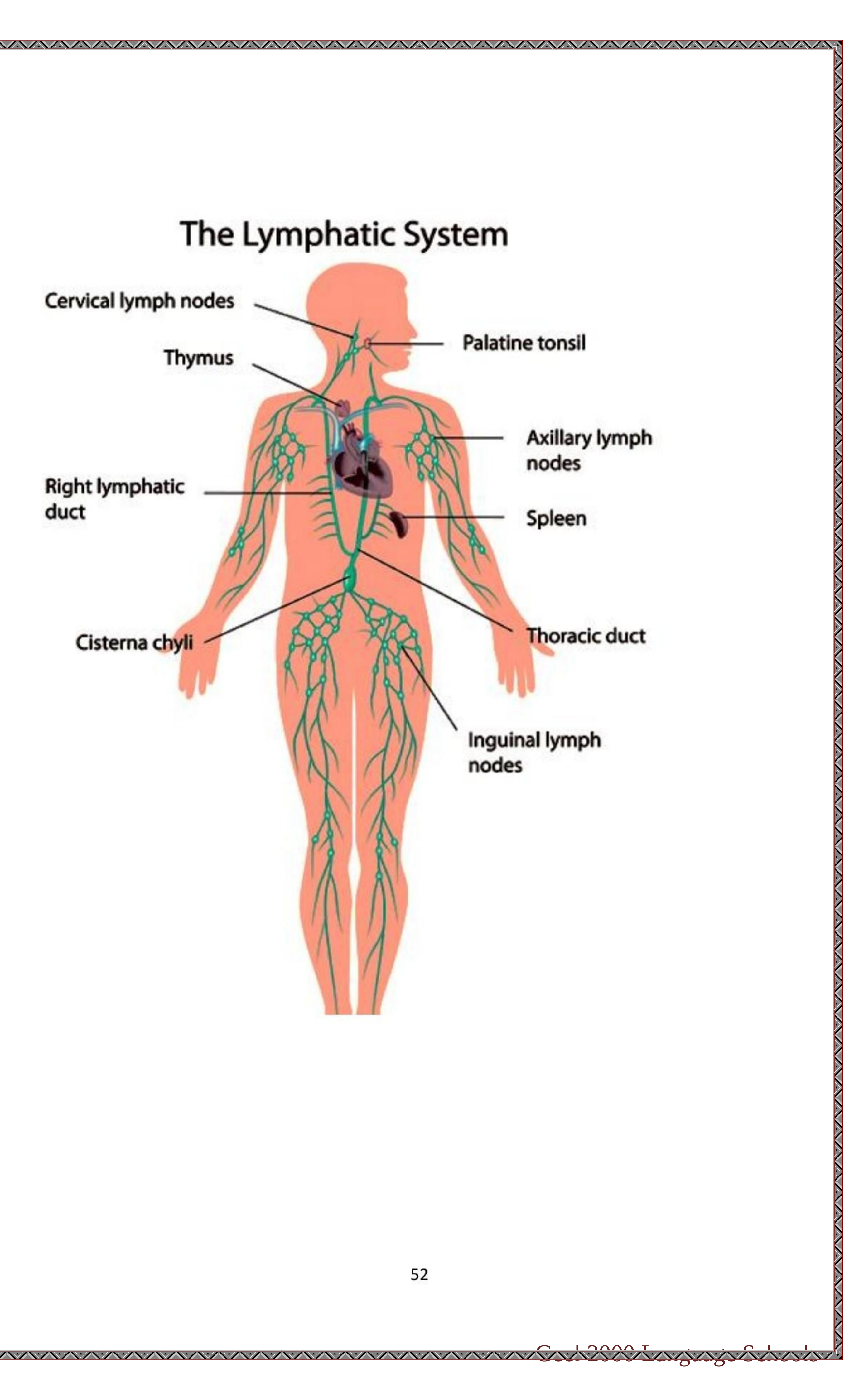
- It is a fluid filtered from blood plasma during passing through blood capillaries.
- Lymph contains nearly most of the plasma in addition to large no. of WBC.

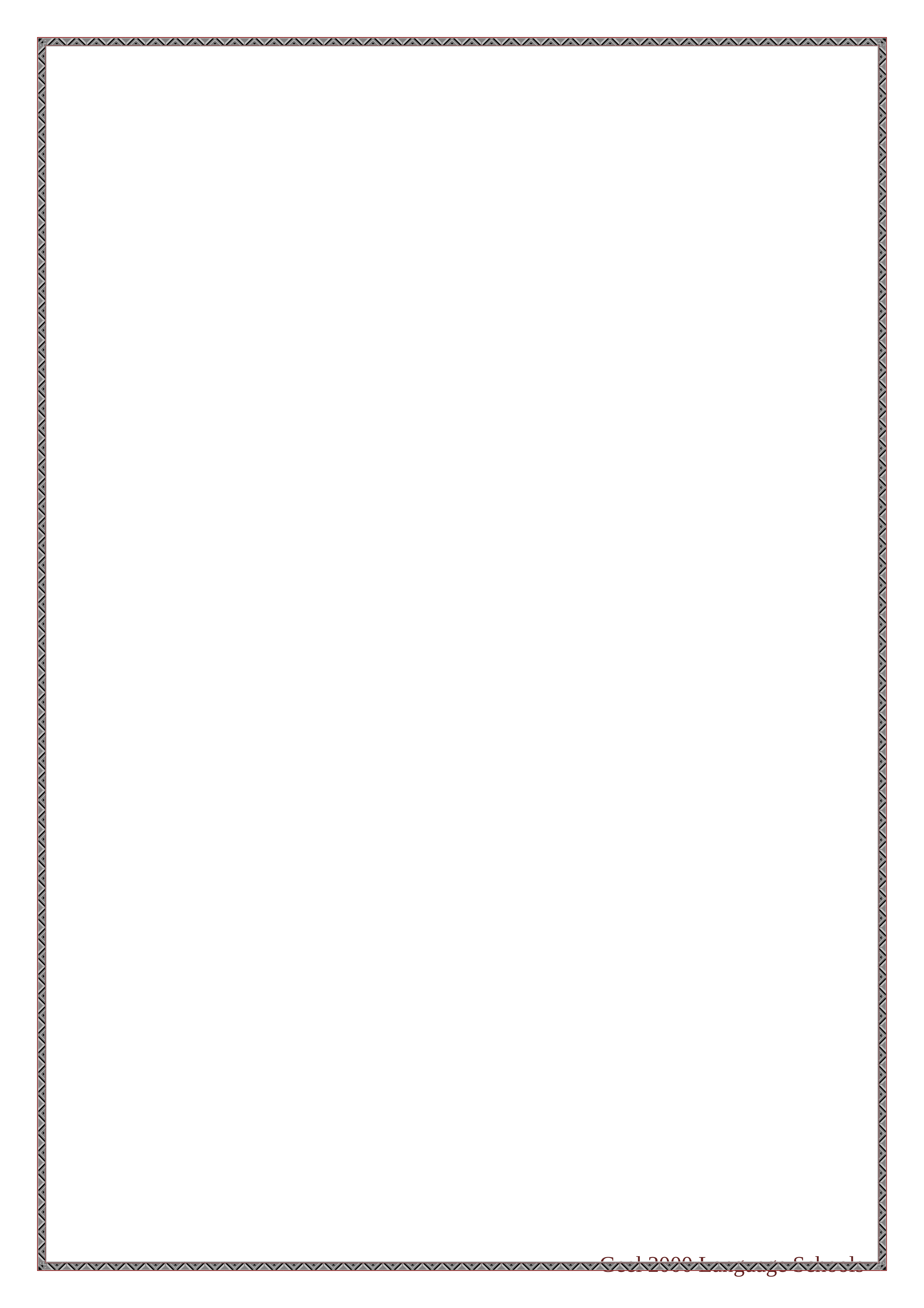
2 Lymphatic capilaries

- The lymphatic capillaries collect the lymph into the circulatory system via superior vena cava.

3 • Lymphatic nodes

- Found at certain points along the lymph capillaries.
- Lymph nodes trap microbes by white blood cells produced by them.


The Lymphatic System
Cervical lymph nodes
Palatine tonsil
Thymus
Axillary lymph nodes
Right lymphatic duct
Spleen
Cisterna chyli
Thoracic duct
Inguinal lymph nodes



Chapter 3

Respiration in living organisms

The difference between gas exchange and cellular respiration:

Gas exchange	Cellular respiration
➢ **Obtaining oxygen** directly from air as in unicellular organisms or by respiratory system as in multicellular organisms and **releasing CO_2** as a final product.	➢ Extraction of energy stored in the chemical bonds of food (sugars as glucose). That is made by green plants and stored in ATP.

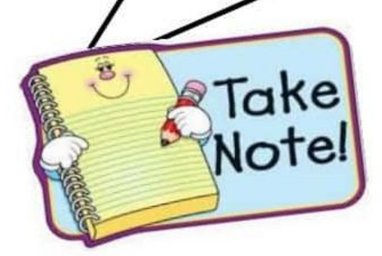
The cellular respiration

The glucose molecule is considered as an excellent example

To study The step of breaking down the food molecule

As it is used by the majority of living organisms to produce

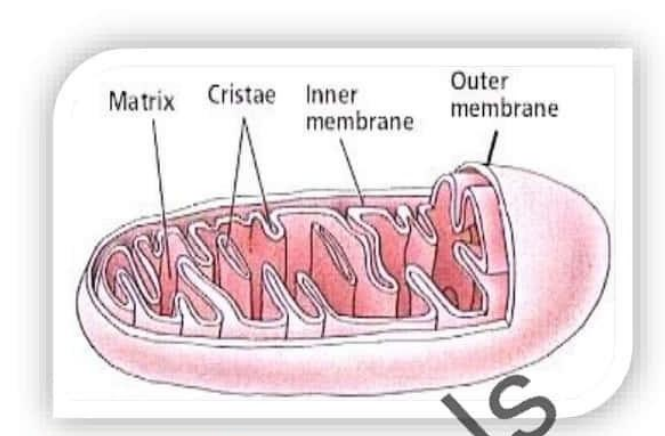
Energy more than any other molecules of available food.



Mitochondria

- **Contains :**

1. The respiratory enzymes.
2. Water.
3. Co-enzymes.
4. Phosphate groups.



Types of respiration

-

Aerobic Respiration

Anaerobic Respiration

Aerobic respiration	Anaerobic respiration
• It requires oxygen for combination of electrons and protons together to form water	• It doesn't require oxygen but occurs by the help of special enzymes
• Part of it occurs in cytoplasm and the rest in mitochondria	• It occurs in cytoplasm only
• The total energy present in glucose is released	• Part of energy in glucose molecule is released
• It produces high energy amounts (38 ATP)	• It produces low energy amounts (2 ATP)
• The final products are simple substance with low energy ($H_2O$and CO_2)	• The final products are organic substances (ethy1 alcohol or lactic acid)

Anaerobic respiration (fermentation):-

The process by which the living organisms get the energy from the food Molecules n absence or lack of oxygen by the help of special enzymes & produces 2 ATP

Types of fermentation

- Acidic fermentation
- Alcoholic fermentation

Acidic fermentation	Alcoholic fermentation
*getting lactic acid. *in muscles & bacteria. *causes muscles fatigue & used in some industries. .	*getting ethyl alcohol & CO_2. * In yeast and plant cell. *used in important industries.

Respiration in living organisms

The respiratory system in man consists of: -

1- Nose or Mouth

The air enters the body through the nose or the mouth but it is preferable (from the hygienic point of view) for air to enter through nose because;

- **It is a warm passage:**

(as it is lined with numerous blood capillaries).

- **It is moist**

(as it secretes mucus).

- **It serves as a filter (because it contains hairs Which act as filter).**

2- The pharynx

Air passes through it which is the common Passageway for bath air and food .

3- The larynx

The air enters the trachea through it and it is known as **(the voice box) .**

4-The trachea

- Its wall contains a series of cartilage ¾ rings which prevent the trachea from **Collapsing** thus maintaining an open passageway for air

- The inner surface is lined with cilia which beat upwards tending to create air and the mucus currents. This impedes (prevents) the entry of small foreign bodies moves them to the pharynx where thy may be swallowed.
- It is divided at its lower and into two bronchi which divide and subdivide into progressively smaller and smaller bronchioles, each bronchiole finally opens into one of the many alveoli (air sacs)

5- The lungs

- Characterized by having a large surface through which gas exchange occurs.
- Consist of a group of alveoli that are connected to bronchioles and the surrounding blood capillaries.

The functional suitability of alveoli

- They are large in number reach to about 600 million per lungs to increase the respiratory surface.
- Their walls are considered the actual respiratory surface because
  - They are thin, so increasing the speed of gas exchanging process.
  - They are surrounded by a large network of blood capillaries whose blood receives oxygen from the alveolar air and from the bronchioles that are connected with them.
  - They are moisten by water vapor which is necessary for dissolving CO_2& O_2

Role of respiratory system in excretion process

- Man usually loses daily about 500cm^3 of water through his lungs out of 2500 cm^3 Of water that he loses daily.
- This is due to evaporation of water that moistens the alveolar membranes & is necessary for dissolving oxygen & carbon dioxide.

Respiration in plants:

The process of getting the chemical energy stored in organic substances (Glucose) Through a chain of reactions which include breaking down f carbon bonds of These substances to carry out the vital activities.

Respiration in vascular plants:

Oxygen reaches the cells through different passageways.

1. Stomata of leaf.
2. The stomata green plants stem lenticels & cracks in the stem.
3. The phloem.

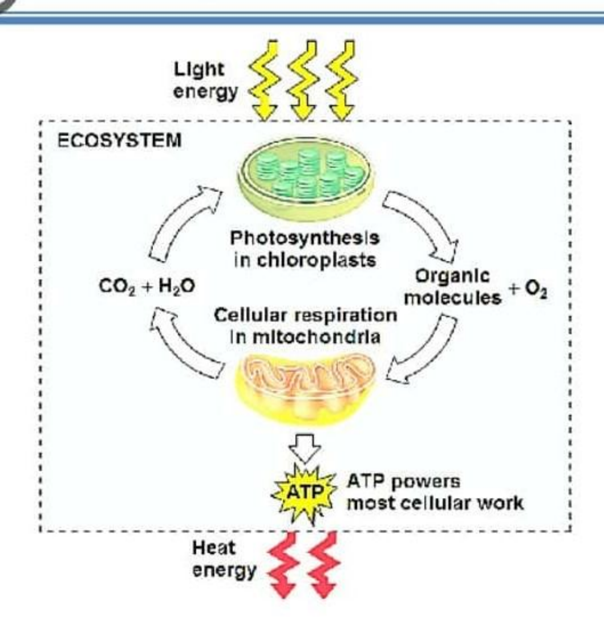
4-The roots (Oxygen soluble in water of the soil & absorbed by root hair)

Methods of CO_2 expelling to outside:-

1- Direct diffusion .(the cells are exposed to directly to environment)

2- Diffusion of CO_2 to xylem or phloem then to stomata then to external atmosphere (the deep seated cells).

The relation between photosynthesis and respiration in plant



Geel 2000 Language Schools